

Providing Customer-Driven, Context-Dependent Environmental Representation in Composable M&S Applications

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10 June 2003

Presented to:

Military Environmental Effects Working Group
71st Military Operations Research Society Symposium
Marine Corps Base Quantico

Briefing Outline

- A Brief History of Providing Environmental Services in Past M&S Applications
- Developing a Flexible Environmental Server Architecture for Composable M&S Applications
- Summary

Observations on How Environment Services Have Been Provided in Past M&S Applications

- The Current Approach for Providing Environmental Service in Distributed Applications (e.g., OASES) is Based on Legacy Concepts from the Distributed Interactive Simulation (DIS) Paradigm of “Pushing” Data and Having Simulation Components Pick Off What They Need
- Environmental Protocol Data Units were Developed to Support the Synthetic Theater of War (STOW) Program and then Updated to Support HLA Applications

Observations on How Environment Services Have Been Provided in Past M&S Applications

- Following the End of STOW, DMSO Created the EnviroFed (EF) Program to Foster and Enhance the Environmental Server Technologies Developed Under STOW
- However, Many Users Would Rather Interact with the Environment (i.e, “Pull” Data or Effects) When and How They Need it Rather Than have the Environment Serve Data to Them (i.e., “Push” Data) at Specified Time Intervals

Observations on How Environment Services Have Been Provided in Past M&S Applications

- The Length of the Various EF and JSB Scenarios was Generally Short, so That There were About 1 or 2 Environmental Updates per Scenario – It Could be Argued that the Environmental Data Could have been Predistributed.

Observations on How Environment Services Have Been Provided in Past M&S Applications

- Just Because you Can Produce a High-Resolution Database (Terrain or Atmosphere) You May Not Really Need it or be Able to Justify it
 - In EF III and FY02 JSB experiments, more atmospheric data were generated than justified by the Federate runtime requirements
 - In an application involving sensors, a high resolution terrain representation may not “buy” you anything if you cannot provide the material properties data required.

Recommendations on How Environment Services Should be Provided in M&S Applications

- The Details of How the Environmental Services are Provided in an M&S Application Should be Driven by the Overall Requirements of the Application Which Would Determine the Selection of a:
 - “Push” or “pull” data service mechanism and
 - Runtime or predistribution of data
- Sensitivity Analyses of the Relevant Physics or Processes (e.g. Operational Doctrine) to be Used in the Application can be used to Determine a “Common Sense” Assessment of the Environmental Spatial and Temporal Requirements

Dispelling the Myths About the Environment and M&S Applications

- **Myth #1:** Including an Environmental Representation in M&S Applications is Hard Because the Environment is “So Big”
- **Reality:**
 - The requirements of the simulation will determine the degree of difficulty required to incorporate any subject domain
 - Any subject domain entity can require a degree of fidelity that can tax a simulation’s resources (e.g., fine spatial resolution, small temporal resolution, first principles physics required)
 - Just because the playbox is “BIG” does not necessarily mean that the environmental representation required must be “BIG”

Dispelling the Myths About the Environment and M&S Applications

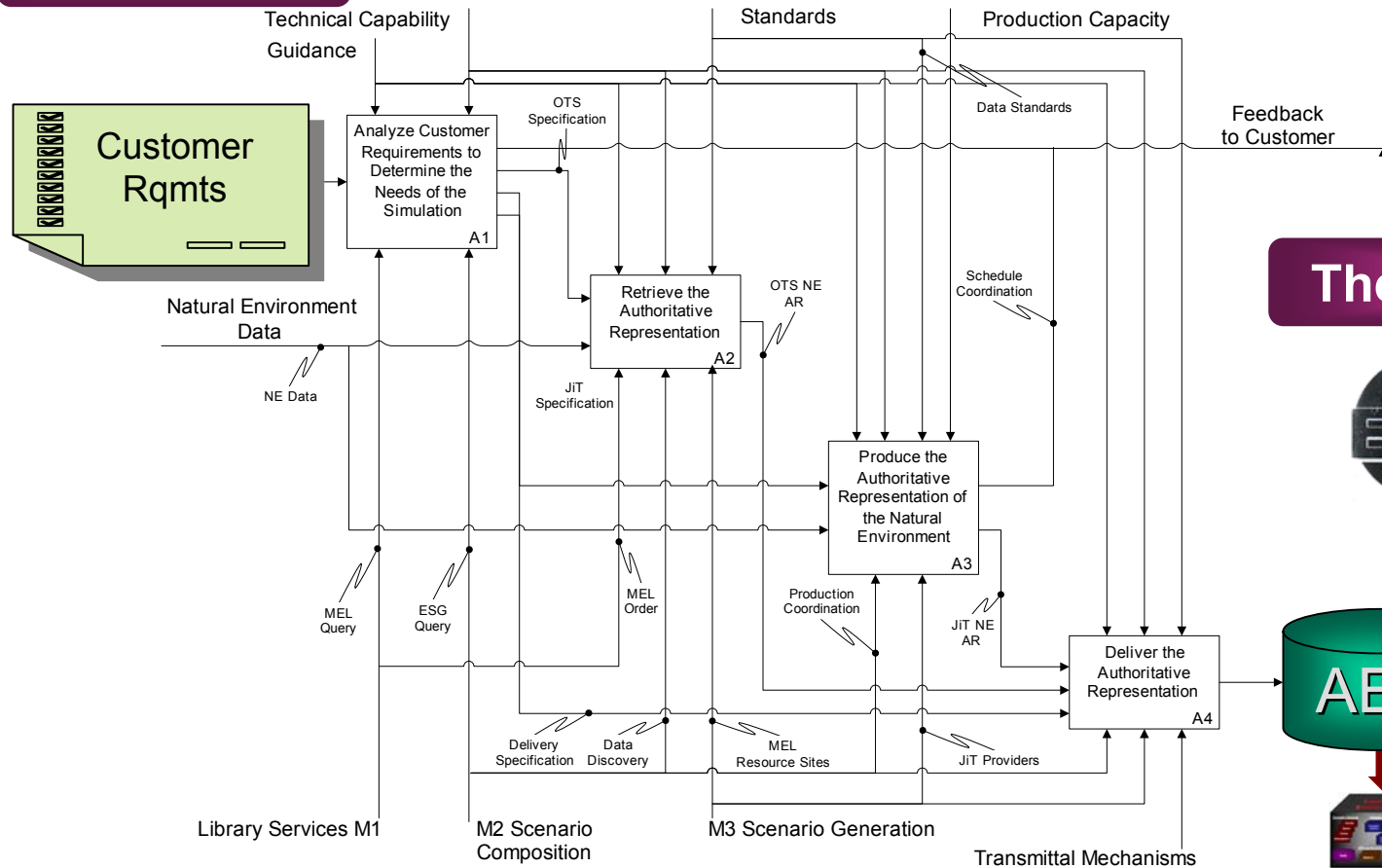
- **Myth #2:** Including an Environmental Representation in M&S Applications Involves Unique Simulation Requirements
- **Reality:** There are No Unique Simulation Requirements for Including Environmental Representation in M&S Applications
 - Any subject domain entity can be created with a large # of elements requiring distribution among the simulation
 - All transmission protocol mechanisms (e.g., RTI) transmit “1’s” and “0’s” and do not know (or care) if a “1 or 0” is an environmental datum or not

Processes & Technologies are Required to Provide Flexible Environmental Representation

- **Processes** are Required to Define the Requirements for the Application in *All* Subject Domains
- **Technologies** are Required to
 - Generate the data in all subject domains
 - Distribute the data during the simulation
- In the Environmental Domain, the Integrated Natural Environment Program (INE) Provides Both the **Processes** and **Technologies** to Generate Authoritative Environmental Representations (AER) for M&S Applications

The INE Program Provides the Process and Technologies to Generate AERs for M&S Applications

The Process



The Technologies



etc.



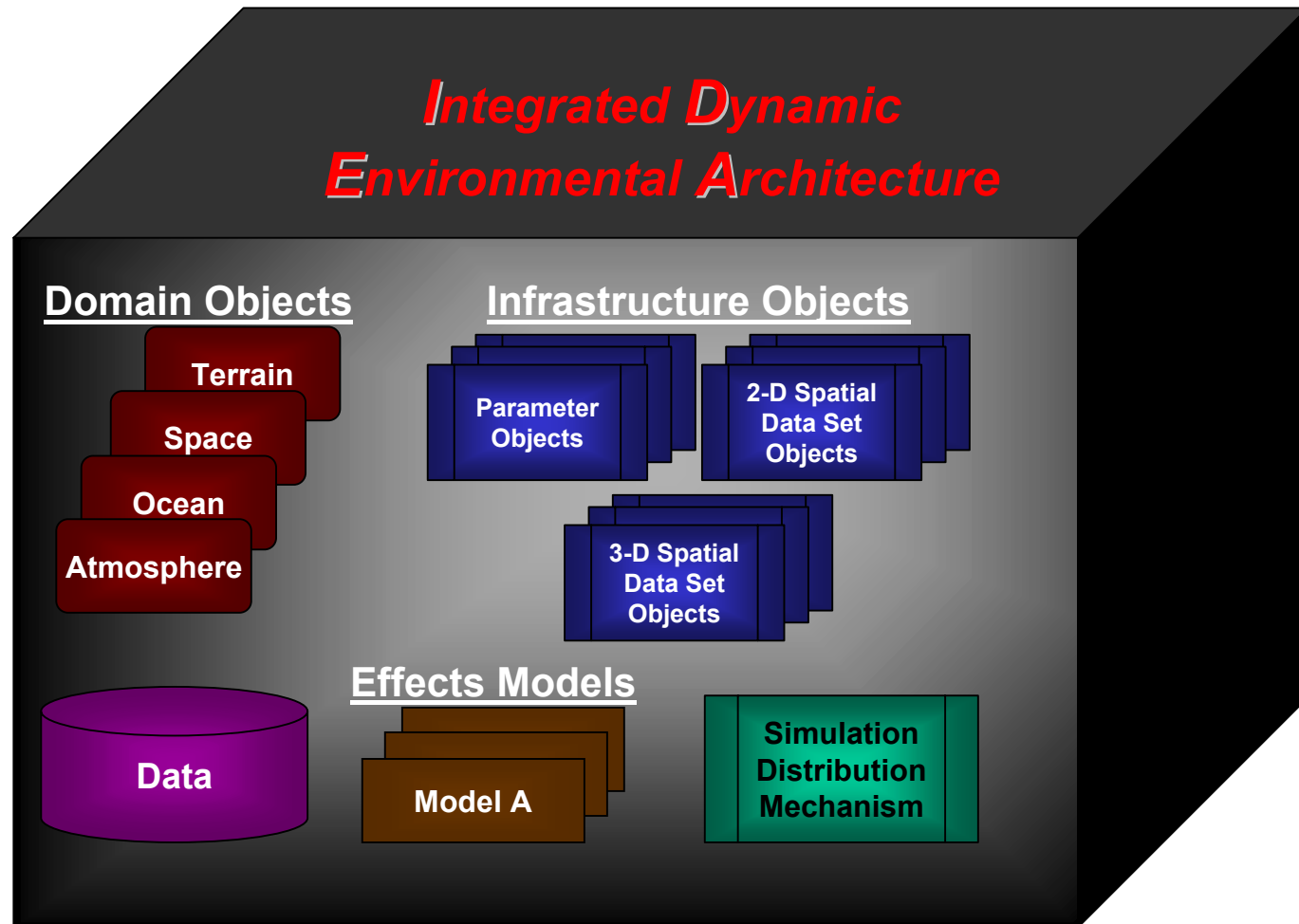
*Integrated Dynamic
Environmental
Architecture*

Simulation

Why is an Integrated Dynamic Environmental Architecture (IDEA) Required for M&S Applications?

- **Why Integrated?** The Different Environmental Domains are Linked by Physics in the “Real” and Simulated Worlds
- **Why Dynamic?**
 - In the “Real” (and Simulated) World, the Environmental Requirements for Systems will Change During the Course of a Mission as Different Mission Phases are Executed (e.g., Launch, Way Points, Refueling, ...)
 - In a Synthetic Environment, the Same Set of Simulation Entities can have Different Environmental Requirements Depending on the “Composition” of the Simulation Context

Functional Components of the Integrated Dynamic Environmental Architecture

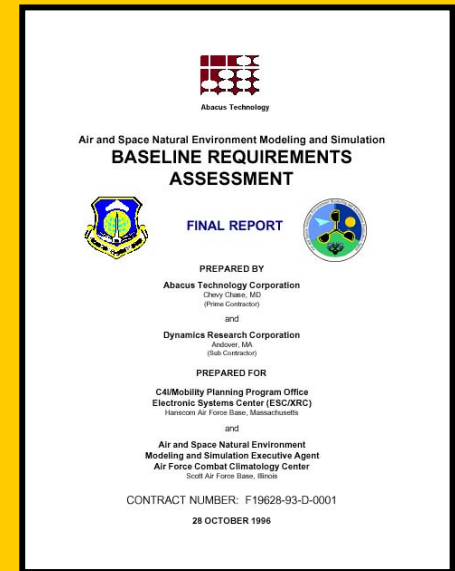
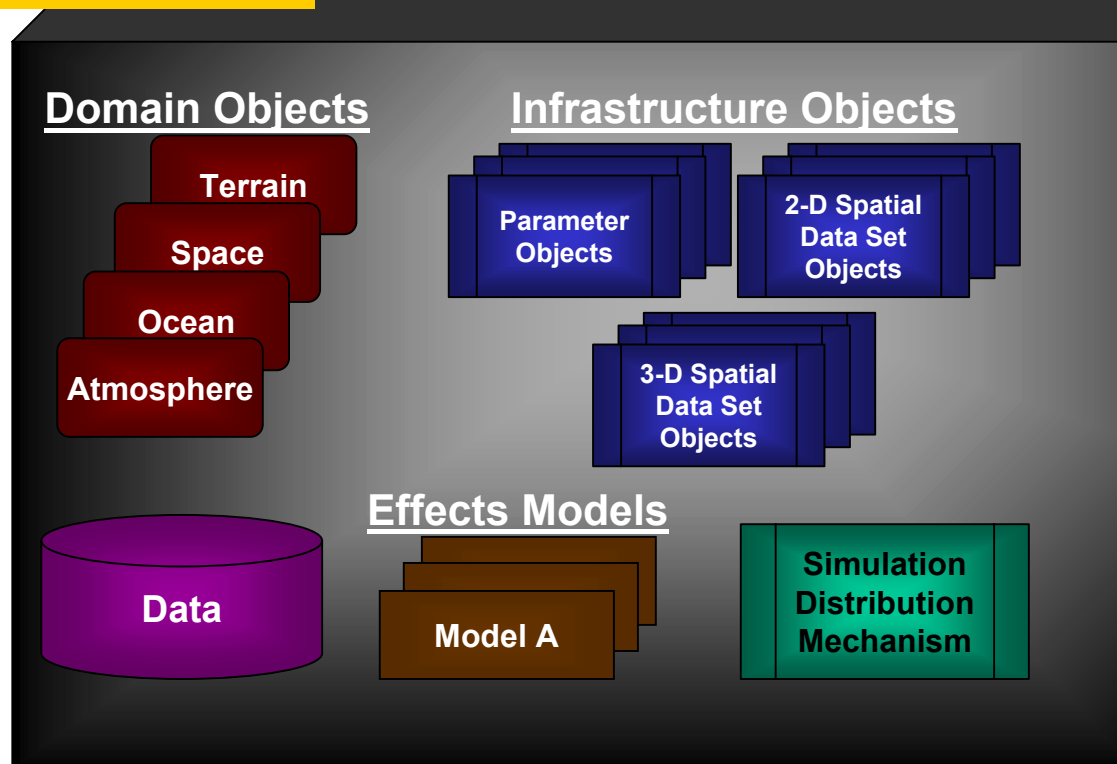


How Will the IDEA Provide a Composable Environmental Architecture?

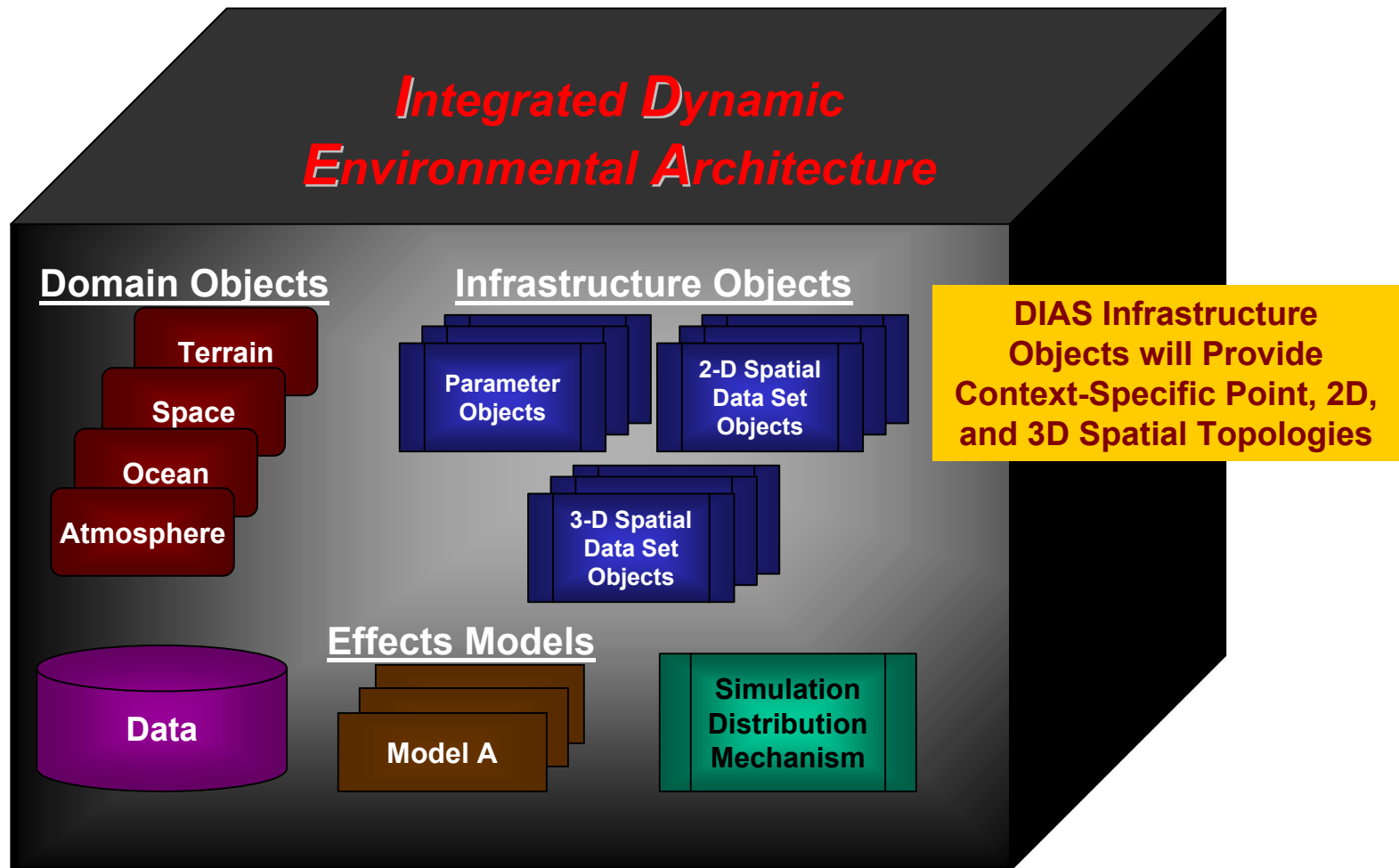
Domain Objects would be Based on DIAS Design Principles of Generality and Abstraction...

Integrated Dynamic Environmental Architecture

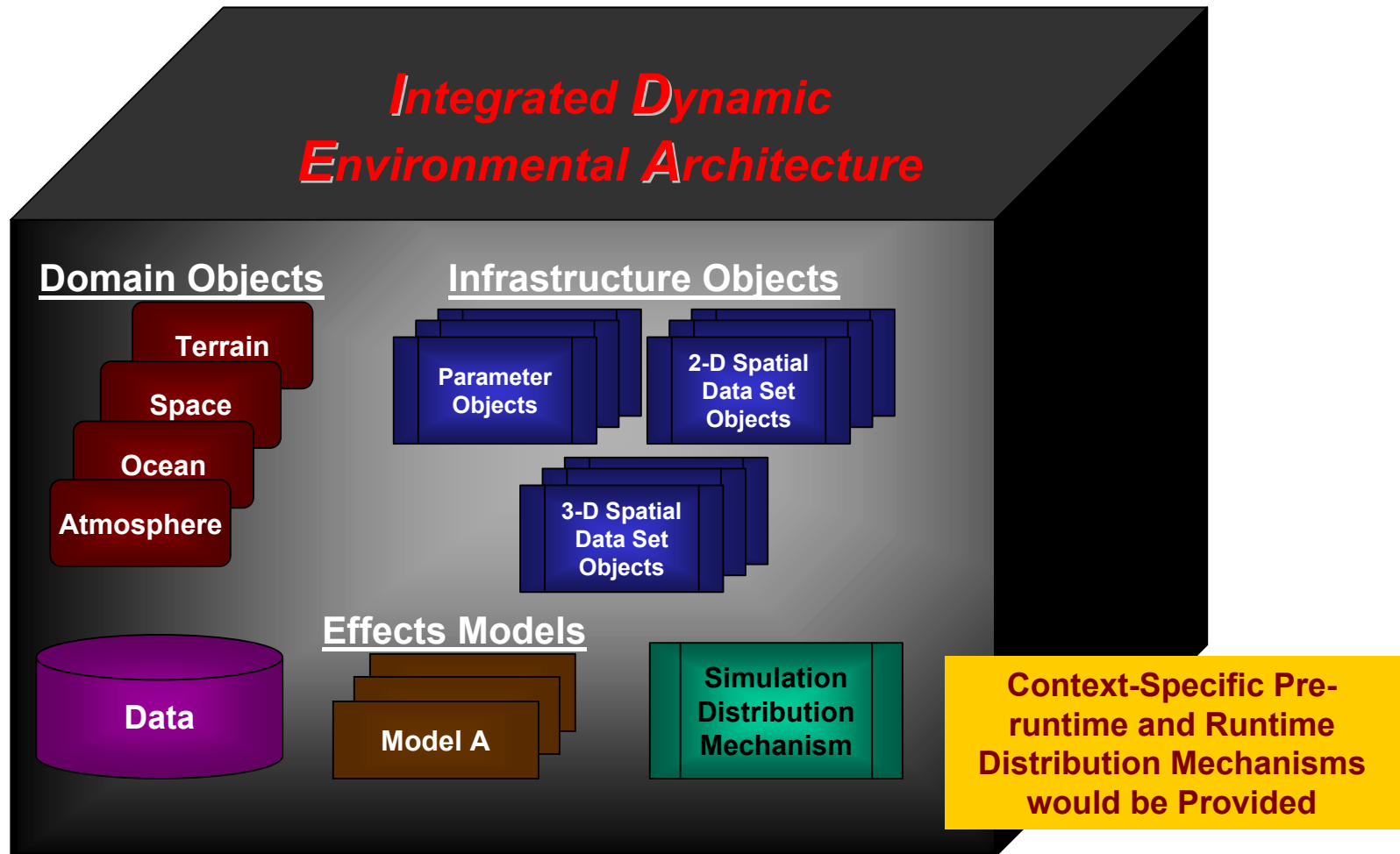
and based on MSEA-Developed Requirements



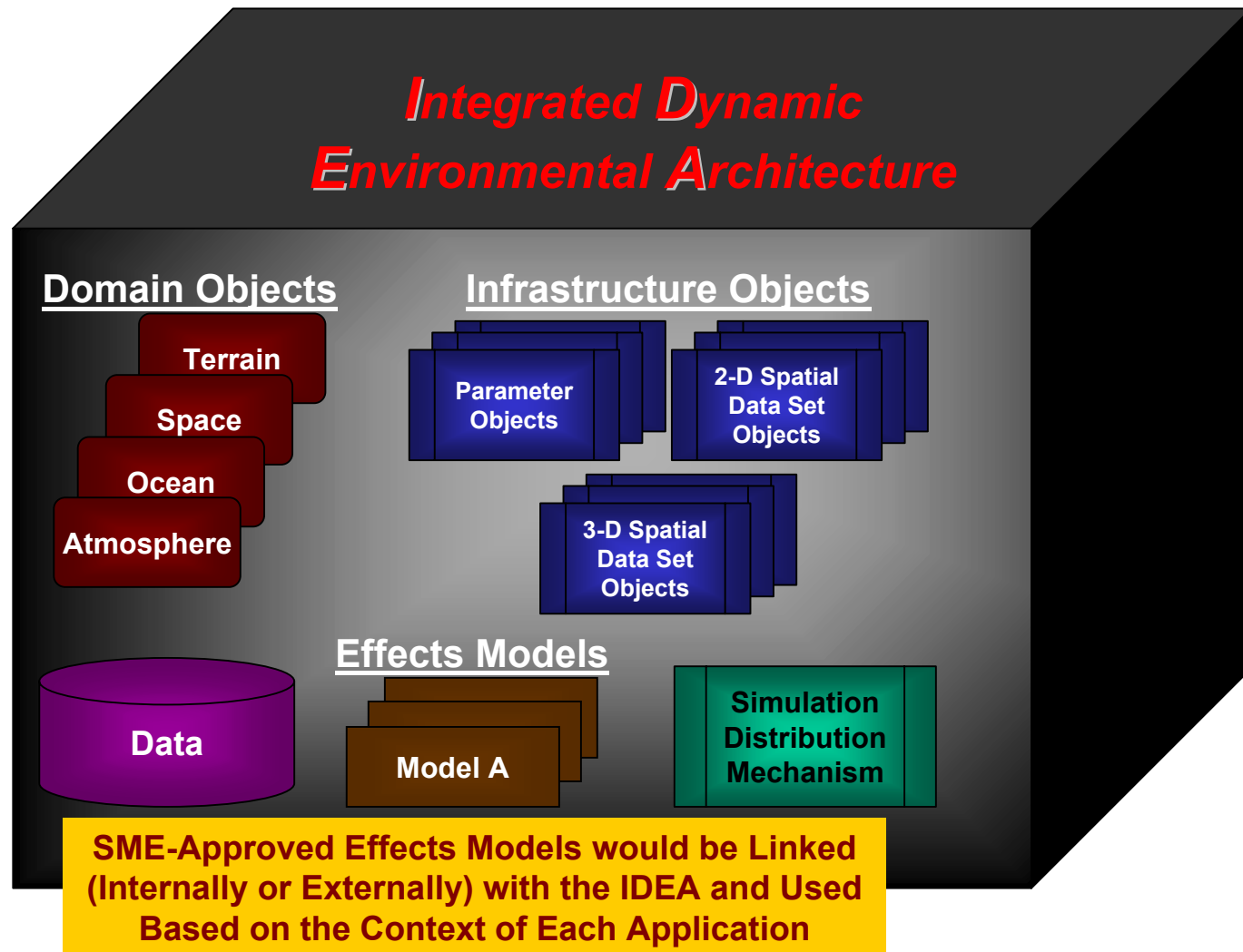
How Will the IDEA Provide a Composable Environmental Architecture? (Cont.)



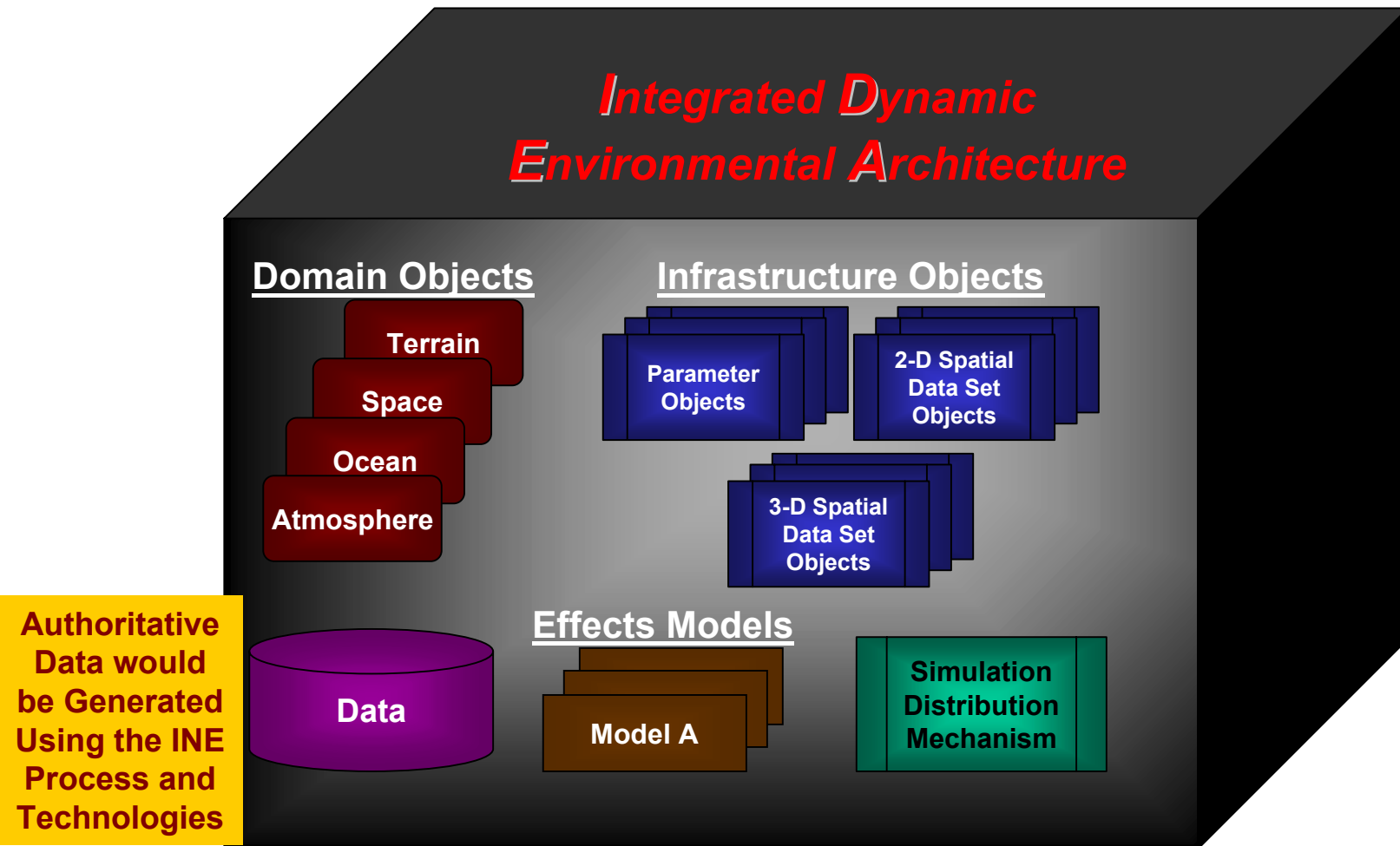
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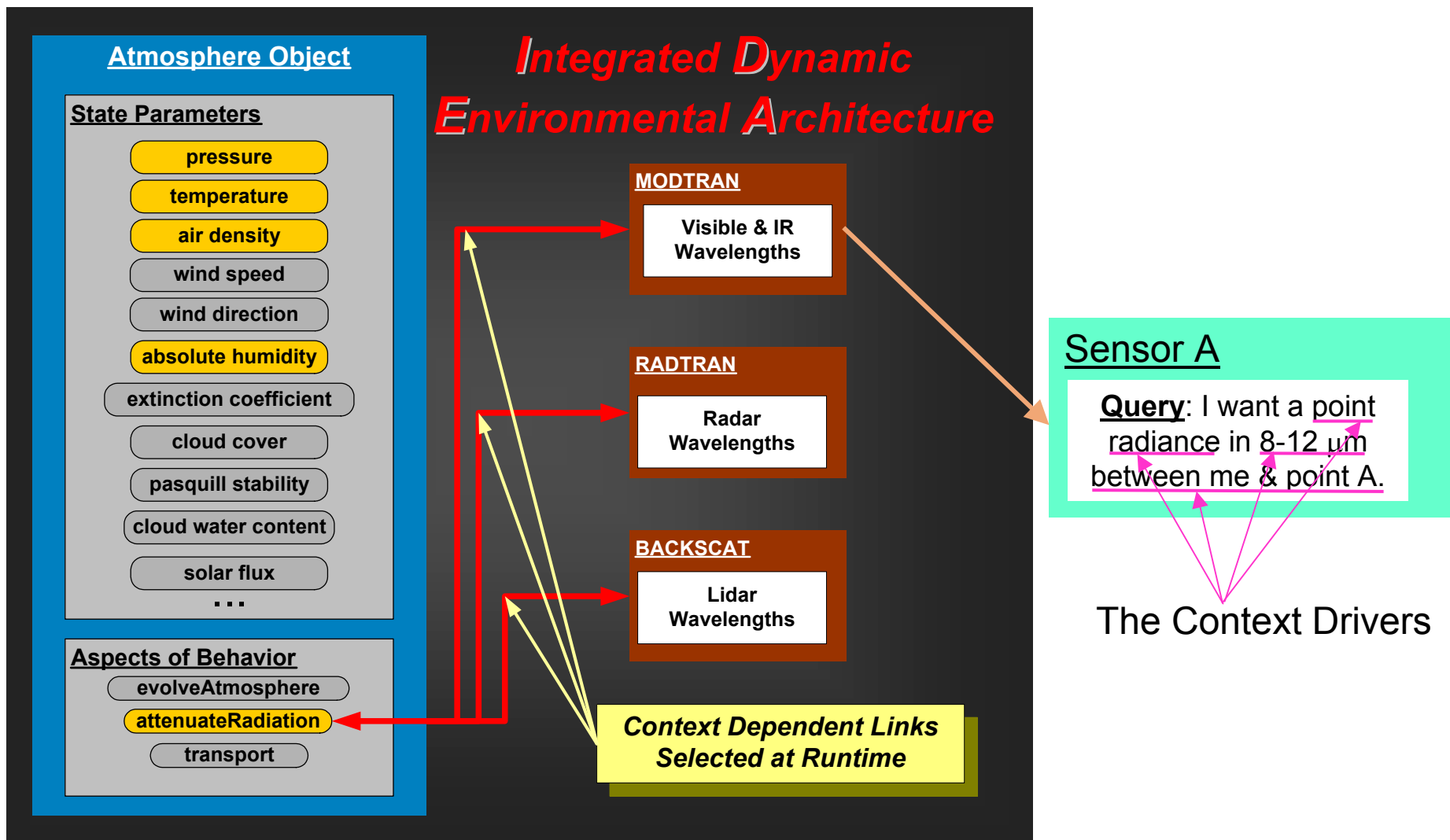
How can the IDEA Support JSB's Needs for Composable Simulations?

- A Review of the Four Use Cases Included in the Draft JSB CONOPS (Source Selection, Engineering Decision, Mission Rehearsal, and Logistics) Indicates that the Requirements for Environmental Representation in JSB Applications will Vary in Terms of:
 - The types of representation provided
 - The spatial and temporal requirements
 - Runtime or pre-runtime distribution

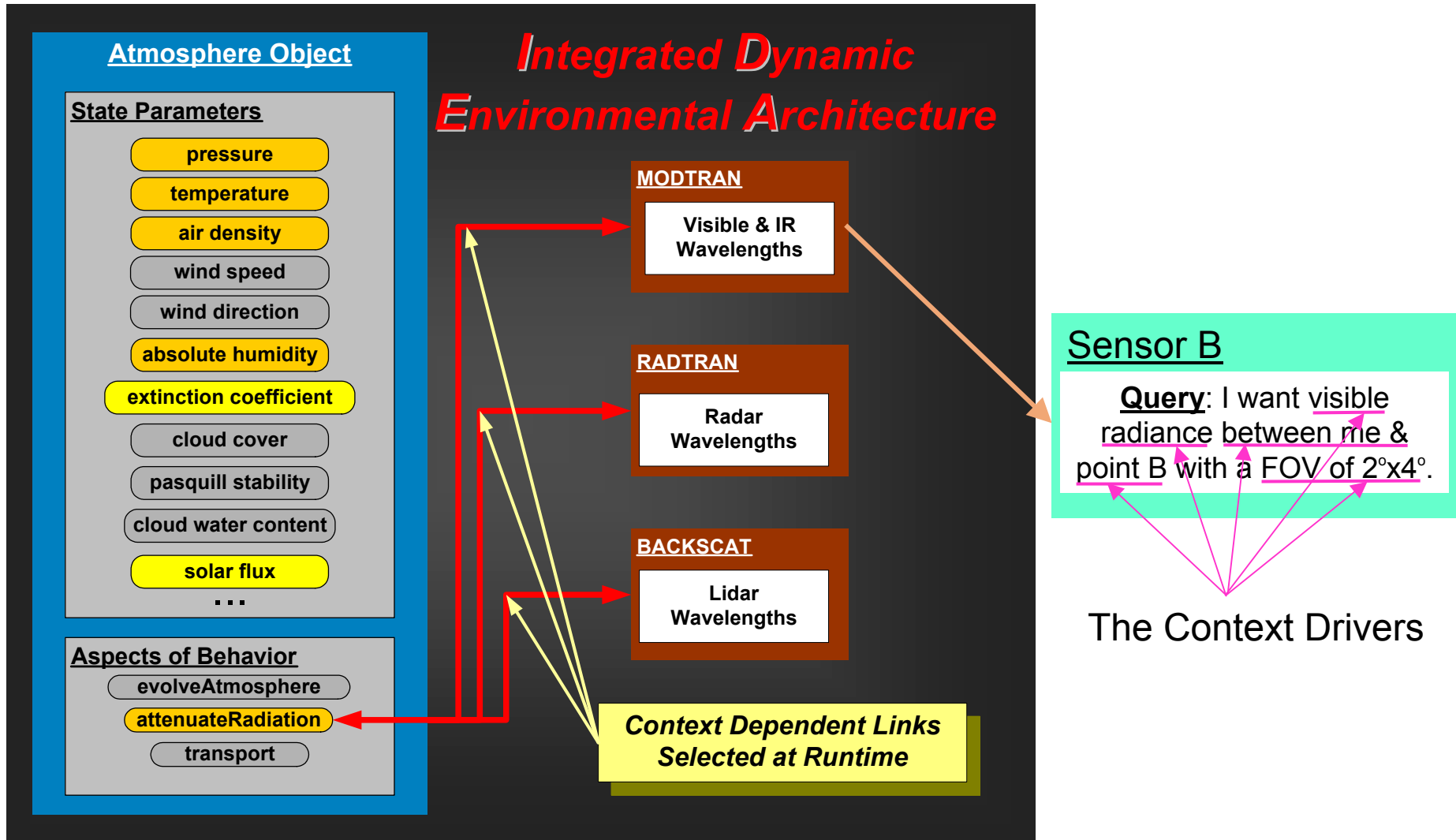
How can the IDEA Support JSB's Needs for a Source Selection Application?

- Goal is to use “...the synthetic battlespace to collect and analyze data concerning key performance parameters for competing Unmanned Aerial Vehicle (UAV) designs to support downselect/selection of the acquisition process.”
- From the Natural Environmental Perspective:
 - An atmosphere (with weather “history”) and terrain AER with detailed background representations at selected locations would be required
 - Atmosphere and terrain data could be predistributed
 - SME-approved signature models would be required to generate context specific data and/or effects via a “pull” mechanism that would be used by multiple contractors with their proprietary sensor models

How can the IDEA Support JSB's Needs for a Source Selection Application?



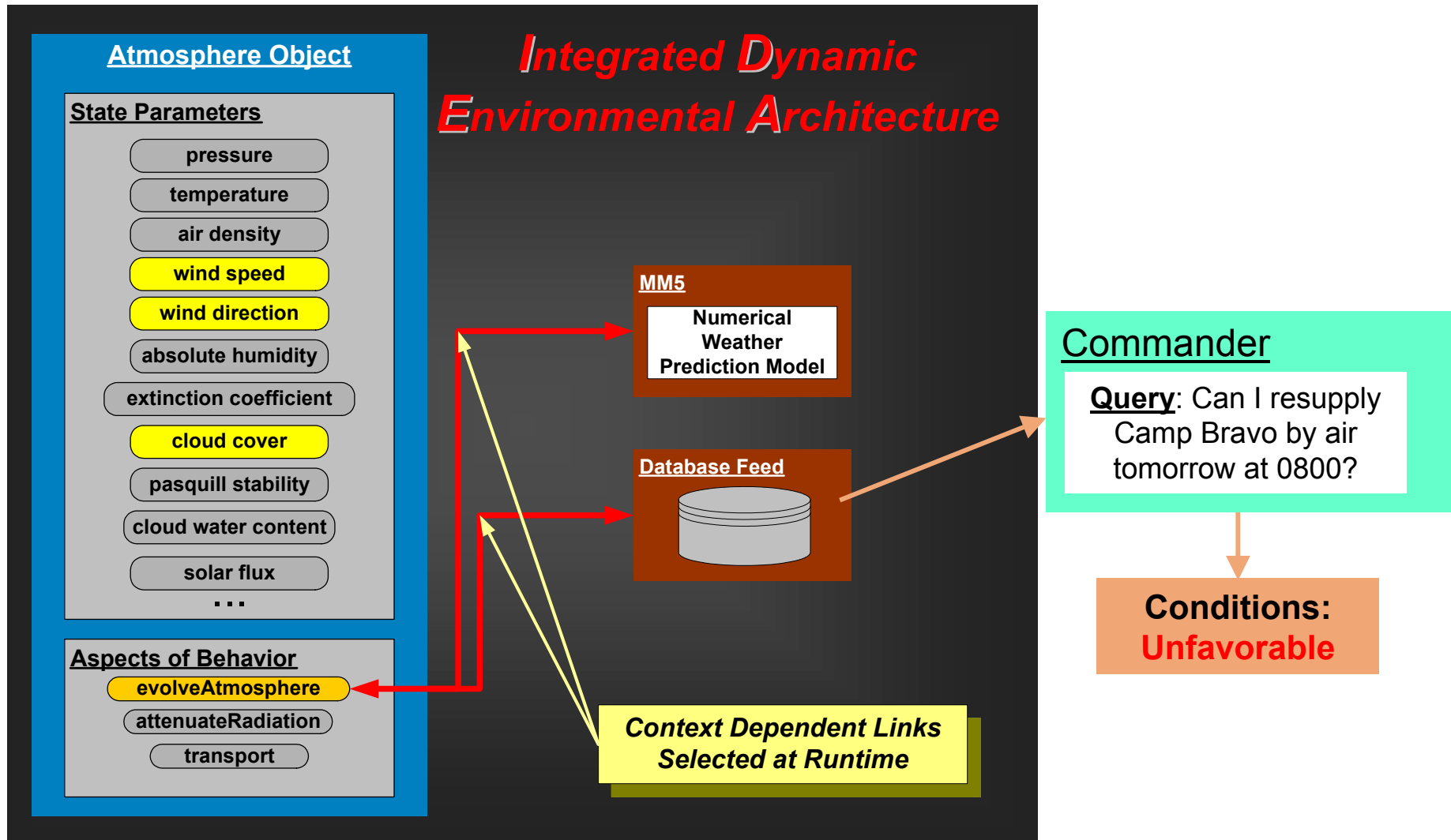
How can the IDEA Support JSB's Needs for a Source Selection Application?



How can the IDEA Support JSB's Needs for a Logistics Application?

- Goal is to use “...the synthetic battlespace to work out the details and prepare for an extended surveillance operations of a remote target inside hostile territory.”
- From the Natural Environmental Perspective:
 - A low resolution (spatial and temporal) atmospheric and terrain AER based on a limited set of parameters would probably suffice
 - Atmospheric data could be pushed or pulled at runtime
 - Terrain data would be predistributed
 - Doctrinal or threshold-based rules (i.e. marginal or unfavorable) could be used to provide environmental effects

How can the IDEA Support JSB's Needs for a Logistics Application?



Summary

- JSB is a Program in Which the Environmental Requirements will Vary from Application to Application in Terms of:
 - The types and resolutions of data/effects that will need to be provided,
 - If the data/effects need to be distributed at runtime or can be predistributed, and
 - How runtime services are implemented (push or pull)

Summary

- The Integrated Dynamic Environmental Architecture can Meet these Requirements:
 - Based on Proven, Government-Owned Technology that Would be Rapidly Transitioned to JSB Ownership
 - Rooted in Fundamental Physics
 - Composable (i.e., Reconfigurable) to Meet Customer-Driven, Context Specific Simulation Requirements